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ABSTRACT

A study of technology students' understanding and learning in mechanics is reported, which was carried out at the Swedish Chalmers University of Technology, in the School of Mechanical Engineering. Data were collected on one group of students' progress through the required courses, and include regular examinations, interviews, a learning session, the recording of specially chosen lessons, and observation of parts of the instruction. A similar data collection effort is underway in 1979-80, based on the preliminary results of the first collection, and the combined results will be assessed for conclusions. It is expected that the study findings will result in proposals for changes in instruction and study planning. (MSE)

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CURRENT PROJECT

TITLE OF PROJECT

STUDY SKILL IN MECHANICS

IN PROGRESS AT

Institute of Education
University of Göteborg
P O Box 1010
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SWEDEN
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in collaboration with

School of Mechanical Engineering
Division of Mechanics
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SWEDEN

SCIENTIFIC LEADER AND PROJECT LEADER

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HE 062-296

BACKGROUND

The research area in question has attracted interest within educational research for a long time. The interest has chiefly concerned the possibility of predicting study success. The problem has been tackled in such a way that the study activity and learning which result in differing study success have not been described at all or have been described very superficially. The previous research carried out in our research group (the INOM group at the Institute of Education, University of Göteborg) has had as its point of departure precisely the need to describe the content of learning and study activity in order to understand the function of

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teaching and studies (Svensson, 1976). Such a research approach has also won increasing international support (cf Higher Education, 1979). The project "Study skill in mechanics" is a continuation of this approach.

Technical education seems to be in particular need of an elucidation of questions concerning learning and study success. The number of graduates from faculties of technology has not kept pace with the increased number of students; on the contrary the number of graduates has decreased. Several investigations and studies have been carried out to give a foundation of data for proposals of measures. The measures proposed chiefly concern altered forms of instruction (more lessons and work in smaller groups) and increased integration of the different elements of the education. Studies of drop-out and study delays confirm that many students of technology have considerable difficulties managing their studies. Above all the problems manifest themselves in that the students have difficulties managing the first year of the education.

In our previous studies we have found decisive qualitative differences between students in their conception of subject content and in the approach used in their thinking during learning in several different social science subjects (Dahlgren, 1975, 1978 /a/; Svensson, 1976; Säljö, 1975). In the light of these results we are interested in describing corresponding differences in the field studied here. A piece of work within the group which is of considerable interest for the project described here concerns concept formation in mathematics and natural science subjects in the upper secondary school. Several interesting results have been reported from this work (Johansson and Lybeck, 1978; Lybeck, 1979). Another current project concerns long-term effects of university studies. People who are taking or have completed a technical education are included as a group in this study (Dahlgren, 1978 /b/).

PURPOSE

The purpose of the project is to study technology students' understanding and learning in mechanics. The subject is also well suited for an elucidation of technology students' study problems more generally. The subject is fundamental in studies of technology. On account of this it is also well suited for an elucidation of the significance of certain background knowledge for studies of technology. The study proceeds from the concept of "study skill" developed previously with the purpose of developing further and extending the previous descriptions to a natural science/technology content. We see ourselves arriving at descriptions of decisive differences in understanding of physical phenomena and descriptions of what is characteristic of study activities which lead to

differing understanding. Here we chiefly make use of physical phenomena for an explanation of which the force concept of classical mechanics is of direct relevance. The aspect of study skill we concentrate chiefly on is thecognitive approach or direction in thinking.

In our previous work we have described two distinctly different approaches of thinking in learning. One was called a deep and holistic approach and the other was called a surface and atomistic approach. The question here is whether these approaches can be found in the current cases and if so in what form. Another question concerns the relation between approach and conceptual background knowledge. This relation is probably different so that in the cases now being studied conceptual background knowledge has a more decisive significance for study skill. The emphasis of the study is entirely on descriptions of conceptions of subject content. A more general overall description of study activity and study success is an amplification which is intended to provide an opportunity to relate the results to the broader context of the studies.

IMPLEMENTATION

The study is being carried out at the Division of Mechanics, School of Mechanical Engineering at the Chalmers University of Technology in close collaboration with two teachers in the Division of Mechanics, Ragnar Grahn and Christian Högfors. It concerns students on the mechanical engineering study programme. The students on this programme study two courses in mechanics during their first academic year. It is on these courses the study is centred. The academic year is divided into four study periods and during each period three courses are studied in parallel. The following courses are included in the first year's studies.

Study period I	*Points*	*Study period II*	*Points*
Mathematics M, part A	*3.3*	*Mathematics M, part B*	*4.1*
Linear Algebra	*3.3*	*Mechanics M, part A*	*4.1*
Mechanical Engineering	*3.3*	*Mechanical Engineering*	*1.7*

Study period III	*Points*	*Study period IV*	*Points*
Mathematics M, part C	*3.3*	*Mathematics M, part D*	*2.1*
Solid Mechanics, part A	*4.1*	*Mechanics M, part B*	*4.1*
Mechanical Engineering	*2.5*	*Physics of Waves and Matter*	*4.1*

The project itself is now planned to last three years comprising in broad terms two years of empirical studies and a last year for final analyses and reporting.

During 1978/79 30 students of technology were followed through the two courses in mechanics. Data collection included, in addition to the results of the ordinary examinations, three interviews, a learning session, the recording of specially chosen lessons, and participant observation of parts of the instruction. The first set of interviews were carried out at the end of October before the beginning of the first course, Mechanics M, part A. A second set of interviews was carried out after the end of the first course in February. Four lessons in part A were recorded. The third interview was done in May during the course Mechanics M, part B in connection with a learning experiment where the students' learning of a section of the course was studied more thoroughly. The collection during part B was a follow-up of the collection during part A with regard to the content selected.

The interviews during this first year aimed at giving a description of fundamental aspects of the understanding of mechanical problems. They concerned the fundamental view of physical phenomena which is represented by classical mechanics and which can be supposed to differ from people's "everyday thinking". The question given most attention during this first year was whether the technology students think in the fundamental concepts mechanics is founded on or in other concepts and, if so, in which. From the repeated interviews we also get a picture of whether any change takes place in this respect during the academic year on account of participation in the courses. The interviews also give information on the study activity in the courses in mechanics. By using the learning experiment in the course Mechanics M, part B we also count on being able to give more thorough descriptions of the learning activity and its relation to background knowledge in the form of the conceptions of physical phenomena described previously. Systematic processing of the material from the first two sets of interviews has begun.

During the present academic year 1979/80 a similar collection will be made. This will, of course, be based on the preliminary results from the first year's collection. The first year's study gives an idea of technology students' understanding of mechanical problems at the beginning of their studies and later on in their studies. This year we have carried out an extensive interview with a new group of 30 students within the framework of the course Mechanics M, part A. The purpose is to be able to give more thorough descriptions of the technology students' understanding of physical phenomena and

of their directions of thinking. After the collection under part A we will assess what supplementary data collection is to be carried out in part B.

SIGNIFICANCE

In its approach the project represents a relatively new type of educational research. Although the area defined by the concept of study skill, as the term is used here, is very extensive and central to educational activity, it has long been neglected. However, the interesting content of the educational activity consisting of the students' thinking and study activity has been attracting increasing research interest. Few would deny that an illumination of these questions is urgent as a foundation both for instruction and for administrative decisions on the design of study programmes.

The more immediate significance of the project naturally concerns studies and instruction of the type studied in the project. It is expected the results will lay a foundation for proposals of changes in instruction and study planning. As development work has been tied to the project, it ought to be able to lead to changes at the department in which it is being carried out. The results and experience can then be spread further. We anticipate that the results will be of significance for the discussion of the problems in post-secondary technical education. We believe that this thorough study of an admittedly limited part of the education can, on account of its character and choice of content, provide a good foundation for a deeper treatment of the problems in post-secondary technical education.

Lennart Svensson

1979-10-08

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